To James Reid Esqre
With the author's sincere regards

A LETTER

TO

THE RIGHT HON. LORD WODEHOUSE,

PRESIDENT OF THE

NORFOLK AGRICULTURAL ASSOCIATION,

ON THE

USE OF CHEMICAL MANURES.

BY

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AND

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LETTER

TO THE

RIGHT HON. LORD WODEHOUSE,

PRESIDENT OF THE EAST NORFOLK AGRICULTURAL ASSOCIATION.

My Lord,

I take the liberty of addressing myself to your Lordship, as the President of the Norfolk Agricultural Association, on a subject in which I feel assured you are much interested, and one which is becoming, almost daily, of more and more importance to all persons connected with agricultural pursuits. I allude to *the general introduction of* CHEMICAL MANURES.

The present state of this country demands the assistance of every man to produce the food which its inhabitants require, at the cheapest possible rate; for without this, we must soon cease to compete successfully with other nations in our commercial transactions; and the misery and poverty which have been gradually creeping upon the poorer classes of our fellow beings must of necessity rapidly increase.

We hear continual complaints from the farmers that, at the present price of corn, they cannot support themselves and their families, upon the profits arising from the cultivation of their farms: by the manufacturers we are told, that the low price of corn in foreign manufacturing countries compels the payment of low wages to the manufacturing population here: and we know that an immense mass of the labouring community is suffering the most cruel privations, and consequent diseases, because the scanty pittance earned will not supply a sufficient quantity of food. This, my Lord, is a state of things which must not be allowed to exist, for it is distressing to contemplate the ruin to which the continuance of such a combination of evils necessarily leads. The question is, in what way can a remedy be applied?

I think it will be generally admitted, that a great step towards this end would be an increase in the produce of the land; and that this is possible there cannot be a doubt. Moreover, by such an effect every class of persons would be benefitted:—devise some means whereby an acre of land can be made to produce an increase of 50 per cent. over and above its present rate of production, (and that sooner or later it will be made to do so, is not to be questioned by any one who has investigated the subject scientifically,) and the principal object will be accomplished. As a proof of what has been done, I would refer to the experiments noticed by Mr. Chaterly on Mr. Hall's

farm, at Havering, in Essex, where the increase of corn on land manured with a chemical agent (sulphate of ammonia,) was 38 per cent. on the wheat, and 12 per cent. on the straw, at a cost of 21s. 9d. per acre. On Mr. Fleming's, where an increase of cent. per cent. was obtained on a crop of potatoes, at about the same cost. If such results as these be generally obtained, the landlord might secure a fair rent; the farmer would realize what he requires by an increase of produce in a given space; the labourer would be more content and better remunerated, and the consumer in supply of the great necessary of life at a cheaper rate.

Were it not for making this letter too long, I could quote facts to bear out the great probability of such an increase of produce as 50 per cent. and even more; but my object is to solicit the attention of the Norfolk agriculturists, through your Lordship as their President, to make trial of certain compositions as manures, which I believe to be (according to all that is at present known upon the subject) more perfect than any others that have hitherto been offered to the public.

Professor Johnston in his admirable "Lectures on the application of Chemistry and Geology to Agriculture," observes "there are periods in the history of every country when the study of agriculture becomes more urgent, and in that country acquires a vastly superior importance. When a tract of land is thinly peopled, like the newly settled districts of

North America, New Holland, or New Zealand, a very defective system of culture will produce food enough, not only for the wants of the inhabitants, but for the partial supply of other countries also. But when the population becomes more dense, the same imperfect or sluggish system will no longer suffice. The land must be better tilled, its special qualities and defects must be studied, and means must gradually be adopted for extracting the maximum produce from every portion susceptible of cultivation." This remark applies most forcibly to Great Britain.

Johnston further states, "If we glance at British agriculture during the last half century—from the introduction of the green crop system, or the alternate husbandry, from Flanders into Norfolk, up to the present time—we find the result of each successive improvement more remarkable than the former. The use of lime, a more general drainage of the soil, the invention of improved ploughs, and other agricultural implements, as well as the introduction of better and more economical modes of using them; the application of bone manure, and more recently of thorough draining, and sub-soil ploughing, have all tended not only to the raising of crops at a less cost, but in far greater abundance, and on spots which our forefathers considered wholly unfit for the growth of corn." The means hitherto adopted to increase crops, and render land more productive, have been almost exclusively mechanical,

and these have been carried to so high a degree of perfection, that any vast and remarkable improvement in this department can hardly be expected. We must now resort to *chemical* science and means, and such assistance will in due time be obtained from it, as will enable the cultivators of the soil to produce a quantity of corn sufficient for the consumption of the whole population of Great Britain; and some gentlemen, more practically acquainted with the subject than myself, believe that in time, far from our being a nation dependent on other countries for a supply of corn, we shall be able to *export* much more than we are now compelled to import. Mr. Smith, of Deanston, whom Professor Johnston states to be~~ing~~ "the introducer of the greatest practical improvements in modern agriculture"—says "*that at least three-fourths of the whole arable land in the country is under very indifferent culture:*" and adverting to the increased produce it may be made to yield, he says, "it is not at all impossible that Britain may become an exporting country in grain in the course of the next twenty years."

In the "Muck Manual," an excellent little work by F. Falkner, Esq. there is the following pertinent remark:—"The quantity of manure consumed by this and that plant is calculated in our writings to the hundredth fraction; and we have analyses without number of the component parts of all the materials applied to forward their growth: and yet, from the

want of accompanying experiments, we know not what manure is!"

The discoveries of PROFESSOR LIEBIG, and of other eminent chemists, who have attended to the subject, seem clearly to point out, that in the improvement of culture we must rely principally on the application of chemical science. Chemistry is intimately connected with agriculture, it embraces the various changes which matter undergoes, and the adaptation of soils, &c. to the transformation of seed throughout all its stages of growth, to the perfected and ripened plant. These changes are entirely dependent upon chemical laws, the investigation and explanation of which are amongst the objects and ends of this science. These circumstances connect it so closely with the practice of agriculture, that a knowledge of the former must materially aid the success of the latter. From the neglect of the pursuit of chemistry, by agriculturists, their important art has received infinitely less benefit from the discoveries of science than any other which is practised by mankind. Every manufacturer, in whatever way he may be employed, readily embraces and applies any discovery that offers the least probability of improving his processes: but the agriculturist really appears to dread any innovation upon his antiquated practices: he seems, generally speaking, to go on as his forefathers did: and hence the cause of the low state of the *science* of agriculture, as com-

pared with any of the other great practical operations of society. It is true that (till very recently) scientific men have not had any encouragement to devote their time to a pursuit from which neither praise nor reward was to be obtained. Mr. Falkner, in the work I have before quoted, very justly says—"The silent expression of Nature has not been rightly understood, because her interpreter—the chemist—has not been consulted, or has been treated with contempt, as a mere book-learned theorist, when he has offered his services to explain her meaning." However, circumstances are changing, the admirable works of Professors Liebig, Johnston, Daubeny, &c. must effect a great reformation. They have done much already, and no man who is interested in agricultural pursuits can read them without profit and advantage. The excellent lectures by Professor Johnston, are so written as to be easily understood by any man of ordinary capacity; the practical rules are as good as the science is sound and applicable; and such works must in time create, as Dr. Daubeny oberves, "that same disposition to discover new methods, and improve upon old ones which characterizes our manufacturers," though "the practical agriculturists, as a body, have always been more opposed to change than any other large class of the community." The thirst for information, and desire for an accurate knowledge of the art through whose instrumentality they live, will, I trust, soon be spreading as much

amongst the cultivators of the soil as it already is amongst artizans ; and this most important of all human employments will, ere long, take that standing in science to which it is eminently entitled.

The scientific chemist and the practical agriculturist must work together,—they must have one object in common,—and avail themselves of the advantages which will be afforded to both, by studying the results which each obtains. In order that correct conclusions may be formed, they ought to understand how plants obtain their food, from what sources they derive the elements of organic life, the nature and operation of manures, &c. ; and all this may be done by a little study and a few well-arranged and carefully-performed experiments. Liebig says, that "experiments are questions put to Nature, and the results of these experiments are her answers."

The growth of plants is regulated by simple chemical laws, and these laws are as definite (at least, all that have been ascertained are so) as any mathematical problem. They who understand them best, and will judiciously apply them in practice, will find the results of their experiments most successful. I admit that upon this subject we have yet much to learn, but still a great deal may be done by an application of that which *is known*. The food of plants, the sources whence they derive it, the manner in which they absorb it, are in great measure known. The changes which organic matter undergoes, and the influence

such changes have on the growth of plants are for the most part understood, and can be satisfactorily explained by chemical laws. The composition of soils can be ascertained, and, when accurately determined, the most appropriate manures may be applied, so as to enable the practical agriculturist to restore to the soil those substances which plants necessarily take from it in their growth.

"Experience in agriculture shows that the production of vegetables on a given surface increases with the supply of certain matters, originally parts of the soil, which had been taken up from it by plants—the excrements of man and animals.—These are nothing more than matters derived from vegetable food, which in the vital processes of animals, or after their death, assume again the form under which they originally existed, as part of the soil. Now, we know that the atmosphere contains none of these substances, and therefore can replace none; also, that their removal from a soil destroys its fertility, which may be restored and increased by a new supply."

The general mode of manuring land appears to me to be practised without any regard to the properties of the manure applied. The agriculturist generally uses *quantity* of almost any kind, rather than *quality* of an *appropriate* kind. I understand that commonly as much as 10 or 12 tons of farm-yard manure are applied to an acre of land. Now it must be obvious

to every one who has reflected upon the subject, that the greater part of this *is quite useless*, possibly *injurious:* and this serves to show how little progress has been made in agricultural *science*.

Land must be impoverished in proportion to the crops raised upon it—the fertility must necessarily be decreased in proportion to the exhaustion of the land by any previous crop—the matter composing the plant must be assimilated from matter contained in other forms in the air, the soil, and the manure. Hence the great importance of adding to the land a manure that is known to contain the identical substances essential to form the food of the plants intended to be raised. Liebig asks, "Is it possible, after so many decisive investigations into the origin of the elements of animals and vegetables, the use of the alkalies, of lime, and the phosphates, any doubt can exist as to the principles upon which a rational agriculture depends?"

It is well ascertained that the soil varies naturally in composition, that it is constantly undergoing changes from chemical action, by the influence of the atmosphere, and the decomposition of the earthy and alkaline salts of which it is partly formed. The most abundant substances in the composition of soils are *silica*, *lime*, and *alumina;* and as these exist in different proportions, so will, in a great measure, be the difference in the qualities of the land. A soil containing a large proportion of *alumina* will be stiff

and tenacious, and will retain large proportions of water :—a soil containing a great quantity of *silica* or sand, and but little *alumina*, will be light and not disposed to retain water. Of course these are always modified by the presence of certain earthy and alkaline salts, as the sulphates, nitrates, phosphates, oxides of iron and manganese, &c. ; but the great mass of the soil varies in consequence of the variation in the proportions of the principal substances I have named. It is obvious, that in order to insure equal productiveness in such soils, they must be supplied with very different kinds of food, or manure.

I think it will be generally admitted that the *promiscuous application* of manures, and consequently their uncertain, sometimes deleterious, results, is a great defect in agricultural practice. For surely that manure must be the best which contains precisely those substances which are known to be absolutely essential for the well doing of the peculiar plant required to be raised. Liebig says—the *phosphates* are the most important substances, and it has been proved that the application of bone manure (which is of use from the phosphate of lime it contains) upon a soil, where they were absent, doubled the produce of the succeeding crop.

Wheat, barley, oats, &c. are known to contain certain earthy and alkaline salts, which they must have taken up from the soil in which they grew ; and not only can these substances be detected, but the

precise quantities of each to a mathematical accuracy. How important then is it to apply a manure that will not only afford all such essential substances, but the necessary proportion of each; for it is quite obvious, that in order to produce a mature plant, in the most perfect state, the most proper food must be administered to it during its growth; just as the most suitable nourishment must be given to a child to form a perfect man. It is therefore of the utmost importance to the agriculturist to inquire how far the fertility of the soil may be increased, by augmenting the quantity of those constituents most essential to the production and growth of his crops.

Liebig remarks "a field in which we cultivate the same plant for several successive years becomes barren for that plant in a period varying with the nature of the soil," and he asks "What is the reason that a field loses its fertility for one plant, the same which at first flourished there? What is the reason one kind of plant succeeds where another fails?" "If a farmer, without the guidance of just scientific principles, be trying experiments to render a field fertile for a plant which it otherwise will not bear, his prospect of success is very small." Mr. Falkner also says that "without knowing of what his plants are formed, that many different substances are required for their nourishment, and that the presence of all those substances is requisite to the *fulfilment of the condition of their growth*, he applies one substance only, an individual

salt; and if it *happens* to be the substance that was wanted to fulfil the conditions of fertility, he gets a crop. Encouraged by this success, the same salt is applied to another field with the full confidence that it will produce a similar effect. In this instance, however, to the great surprise and disappointment of the farmer, it proves an entire failure. Induced by the success of the first application, other persons try the same salt, some with entire success, others with partial benefit; but the greater number without any perceptible advantage. Further experience of this kind plainly proves that there is no dependence to be placed upon this particular salt, and it is ultimately abandoned. Such has been the fate of several different salts in succession, and thus common salt, gypsum, carbonate of soda, nitrate of soda, and nitrate of potash, have each had their periods of favour and disrepute. A few successful experiments with a particular salt have led to an extensive application of it, and to consequent great loss and disappointment."

"*Neither plants nor animals can live unless their food contains* ALL *the elements of which their substance consists.*"

"When the farmer stands in need of a substitute for his own proper manure, farm yard dung, as he cannot with certainty tell what is in the land, he should obtain one that contains, if not all the substances in that dung, at least those which are most likely to be deficient."—*Muck Manure, p.* 144.

Science points out what these substances are, it exposes us to no danger of failure, but, on the contrary, it furnishes us with every guarantee of success. If the *cause* of failure—of barrenness in the soil for one or two plants—have been discovered, means to remedy it may readily be found.

It seems that *all* plants require for their growth and nourishment the presence, in the soil, of the alkalies and alkaline earths ; but each takes up but a certain proportion, and that proportion varies in different plants. Others require as well as the alkaline earths the presence of *silica*, or flint, in a soluble condition. The whole class of *cerealia*, such as wheat, barley, oats, &c. cannot thrive without its presence, it is a constituent part of them, and the productiveness or otherwise of crops of corn depends very much upon the proper quantity of silica, and its combinations, being present. To prove the great importance of a knowledge of soils, I need only quote the recent report of Dr. Robert Thompson, of Glasgow, respecting the great difference in the nutritive properties of different wheats. He says, " there is still a kind of inquiry relative to agriculture, which forms the connecting link between that art and the science of health, and is therefore of equal value to the student of medicine and agriculture. I refer to the amount of the nutritive part of grain. *Bread contains the elements of the blood*, and in proportion as the amount of the principles calculated to produce

this fluid is greater or less in the aliment consumed, so is the latter possessed of superior or inferior nutritive power."

	Nutritive Principle.	
Naumberg (in Prussia) Bread	16 . 49	per cent.
Dresden Bread	14 . 30	" "
Berlin ditto	14 . 21	" "
Canada Flour	13 . 81	" "
Essex ditto	13 . 59	" "
Glasgow Bread	13 . 39	" "
Lothian Flour	12 . 30	" "
United States Flour	11 . 37	" "
Do. do. do.	10 . 99	" "

It therefore appears that 100 parts of the Naumberg bread are equal in nourishing power to 150 parts of the United States flour: and I have no doubt there is as much difference as this in wheats of our own country, arising entirely from the chemical difference of the soils in which they grow.

It is not only the health of *man*, but also that of *cattle*, which demands attention to the composition of soils; for it is observed by an author whom I have before quoted, "That in certain situations the bones of cattle and horses are very defective in solidity and strength, owing to the deficiency of bone-earth, or phosphate of lime." The same author thinks "It is highly probable that a similar deficiency in our dairy pastures might, in many situations, have an effect in affecting the quality, if not the quantity, of milk,

which always contains the phosphates of lime and magnesia in considerable quantities." The salts of ammonia, and the phosphates, are by far the most valuable parts of manure; and these, in the ordinary methods of collecting and exposing manures are principally evaporated or washed away.

An opinion is becoming pretty general, that in time the three-course and four-course crop system will be abandoned, and that *a succession of the same crop* may be repeated year after year, *ad libitum*, by the application of artificial manures; and many very acute men who have taken up the study of chemical manures, do not hesitate to affirm, that in a few years we shall see the produce of corn, in every well cultivated field, double its present ratio!

I may be told that before this can be effected every farmer must be an accomplished analytical chemist—that he should be able to make a correct analysis of the soil of every field before he begins to manure it: and that he ought also to be sufficiently acquainted with the most suitable manures to be applied, before he can insure the most successful crop. There will be no necessity for this—abundance of chemical talent may be found in this country to answer such a purpose. Show a probability of remunerating a man of science for the application of his acquirements (which are always attended with great mental labour, and much expense) and you may secure his services. I have no doubt that in a short time, as the adoption

of chemical manures increases, a race of analysts will rise up, who will apply themselves to the examination of soils *professionally*.

Though it might be advisable to examine every field with chemical accuracy, in order to adopt the means of raising the most profitable crop, by applying the most suitable manure, still I conceive that by using one which is known to contain *all* the ingredients that are *absolutely necessary*, we gain a point in agriculture that has not been acquired before: for though we never can expect to discover a compound that will be equally efficacious in all cases, in consequence of the great variations in the qualities of soils, any more than we can find an universal medicine for diseases of the human body, still, we know that certain classes of medicines may be applied, as tonics, &c. with desired effects; and by the same rule certain classes of ingredients may be applied with equally good effect, as tonics and nourishment, to land.

We have heard much said in favour of the nitrates of potass and soda when used as a top dressing, but as Dr. Daubeny observes, in his third lecture, "It is remarkable, that the nitrates, whilst they have in some cases occasioned a wonderful increase of produce, in others have appeared of little service; and also that, whereas on certain land both were equally efficacious, on a different description of soil one has answered whilst the other failed."

The same may be said of bone dust, and of several other substances used, *per se*, as manures, and the cause of their failure is obvious to every chemist. No *one* salt can succeed in producing a luxuriant crop, on a hitherto barren soil, unless the particular salt essential to the growth of the plant be absent in that soil; but in compound manures such an effect is not likely to accrue. If any manure containing *only one* ingredient produce a beneficial effect, it is obvious that that particular substance was not present in the soil, at least in sufficient quantity, before the application of the manure. But whenever success attends such an application as this, it becomes almost universal: it is indiscriminately applied to *all* lands, and the consequence is, that it becomes indiscriminately abused. Mr. Falkner, in his excellent work, the "Muck Manual," which I have already noticed, makes the following remarks upon the subject:—

"The seeming capriciousness of the effects of particular salts, when applied as manures, can be explained only upon this principle. With such a view of the subject, we may readily understand why a particular salt, which has produced a great effect upon one soil, affords but little benefit upon a second, and utterly fails in a third. It will produce a *great effect* when that particular salt *happens* to be deficient in the soil, and all the other substances required by the plants exist in it in sufficient quantity. It will produce a *moderate* effect, when the deficiency

of that salt is not considerable, or when some other salt or salts are deficient. It will produce *no effect at all* when it is already abundant in the soil, or when some other substance, equally required by the plants, is very deficient, or altogether absent." It consequently follows, as I have before remarked, that *that manure must necessarily be the best which contains* ALL *the various salts that are known to be required for the most successful nourishment of plants.*

Now I believe that *guano* contains more of those substances than any other natural manure, but to the use of this there are some very strong, indeed almost fatal, objections. In the first place, *guano* can rarely be procured in this country in a good state: and, besides this, no two samples are alike, if even it is what is called by the dealers in that article, "*pure;*" by which they mean unadulterated *by them.* Guano gathered from the same locality varies greatly in quality. A gentleman from Peru, whom I have lately seen, and who is well acquainted with every thing relating to guano, assures me that the quality of that article is sometimes as different as possible, though it may be collected within two or three yards of the same spot. The guano is the excrement of sea fowl, which has undergone various decompositions from exposure to the atmosphere, &c.; and were it gathered exactly at the proper moment, and applied to the land in its most perfect state, it would be a very superior manure indeed: but unfortunately it is

seldom obtained till most of its ammoniacal properties are evaporated, and consequently some of its best qualities gone, probably the *very best* that could be employed, for Liebig calculates that every pound of ammonia which evaporates is equivalent to a loss of 60 lbs. of corn. Besides this defect, guano contains large quantities of sand, sometimes to such an extent as to disappoint the farmer. It is open to enormous adulteration when it arrives in this country; for it gets into the hands of unprincipled dealers, and they do not hesitate to mix with it large quantities of ground spent oak bark. I have recently analyzed a sample of guano, and found that it contained 32 per cent. of woody-fibre (most probably spent bark) and sand. This was called a *genuine* sample, and for which a good price had been paid. These are very sufficient reasons why the article is in such disrepute amongst some who have tried it. Independently of all this, I do not think that guano, even if it could be obtained in its utmost purity, and in as good a state as it is found in Peru, under the most favourable circumstances—can ever be as serviceable in our country as it is in *Peru*. Guano in Peru, *remains in the soil*—carried up and down by the capillary action of that soil—according to its moistness or dryness at the surface—dependent upon the relative quantity of *dew* only, rain being almost unknown. But in this country, where rains are frequent and uncertain, much—very much—of the

most valuable parts of it, must be washed away and carried off by the ditches.

How much more advantageous therefore must it be to use an artificial compound, containing all the necessary properties from which plants derive their nourishment;—a compound which shall be gradually decomposed by the united action of air, light, and carbonic acid, and then assume a soluble and easily to be assimilated state; so as to furnish the plants with a steady and constant supply of nutriment. Such a compound I trust has been formed, the effects of which I will presently explain.

Professor Johnston says (after stating that the practical farmer rejoices in having one ton of bone dust, the equivalent of 14 tons of farm-yard manure), "Some of the most skilful living chemists predict that methods will hereafter be discovered for compressing into a still less bulky form, the substances required by plants, *and that we shall live to see extensive manufactories established for the preparation of these condensed manures.*" There can be no question on this head; they are *already begun*, and it has been satisfactorily proved that 2 cwt. per acre, of a manure containing the essential ingredients, and those only, have done more to produce a prolific crop than 14 tons of such manure as is usually employed by farmers.

On the event of chemical manures being generally adopted, if even they should prove to be no *better* in

their results than farm-yard manure, the obvious saving in horses and manual labour, by using 2 or 3 cwt. instead of 14 or 15 tons, must be apparent to every one. Hitherto, as has been already remarked, scientific men have had but little inducement to devote their time and talents to agriculture, because it has held out no promise of reward: but if they find on the part of the agriculturists a disposition to remunerate them for their labours, much scientific knowledge and a host of cultivated minds may be called into action; and, by the united efforts of the chemist and the practical agriculturist, enormous good must accrue.

Early in the year 1842, Mr. James Phillips, of Ampthill, an excellent chemist, prepared a manure which, after many trials, gave very satisfactory results: he was induced to form a connection with some Chemical Gentlemen for the purpose of manufacturing manures on a larger scale, and from that time to the present they have carried on the business under the name of the "*Chemical Manure Company*,"

This manure was analysed by Dr. Ure, and I subjoin a certificate of his analysis:

From Dr. Ure, M.D. F.R.S. F.G.S. &c. Professor of Chemistry, and Analytical Chemist.

I hereby certify that I have subjected some of the manure prepared by Mr. James Phillips, of Ampthill, to the analysis recently invented in the laboratory of Dr. Justus Liebig, and I

find it *much stronger in fertilizing animal and chemical products* than the best guano in the market.

To Mr. James Phillips. ANDREW URE.

London, March 8th, 1842.

In the same year several gentlemen made trials of the manure, and the following are their testimonials respecting it:

From Rev. John William Coventry Campion, Westoning, Bedfordshire.

Sir—The concentrated guano, which you sent me last year, was tried upon three parcels of ground, one of which was grass, and the other two wheat.

The hay crop, when dressed with the above-mentioned manure, was decidedly superior to the rest of the field, and the parcel of land was easily distinguished, a week or two after dressing, by its verdure and freshness. We did not perceive much alteration in the wheat until harvest, when the sheaves were much heavier, and the ears of course much more productive, than those on the adjoining land, where the manure was not sown. The guano was sent late to us last year, and consequently had not a fair trial; it is my intention, this year, to sow it earlier, when the weather is not too dry, and anticipate more favourable results.

Yours obediently, J. W. C. CAMPION.

January, 1843.

From Mr. John Lines, Mortgrave Farm, near Luton, Bedfordshire.

November 28, 1842.

Sir—I tried the guano upon a piece of wheat, upon thin weak staple land, when the plant was looking dreadfully bad; afterwards it improved rapidly, although the season was very dry, and at harvest there were four bushels to the acre more than the other part of the field adjoining, it having been sown 1½ cwt. to the acre.

Yours truly, JOHN LINES.

From Mr. Francis Green, Houghton Conquest, Bedfordshire.

December 31, 1842.

Sir—In reply to your inquiries about the success of the concentrated guano, I beg to inform you, that soon after its application, the appearance of the crop was very much improved, and the produce was so increased, that I shall give it the preference to any other artificial manure.

Your obedient servant, FRANCIS GREEN.

From Mr. G. O. Clarke, Fenny Stratford, Buckinghamshire.

October 28th, 1842.

Dear Sir—I tried your guano on a piece of very poor land, on Talavera wheat that was drilled on the 19th of February; it was drilled in with four horses at length, and I did not expect to have much of a crop; it was, however, the best piece of wheat I had.

About three acres was dressed with guano, and the remainder of the field with a compost of lime, brick-ashes, and mould—the former was the best wheat, stronger in the straw, and larger in the ear; but I cannot give you the yield, it being put into a small hovel; I will do this the first opportunity.

I am, dear Sir, yours truly, G. O. CLARKE.

From Mr. Samuel Mossman, Maulden, Bedfordshire.

Sir—In reply to yours of the 27th instant, requesting information of me respecting the application of the concentrated guano tried by me last season, and the result experienced therefrom, I beg to state, that it is my opinion it is a good artificial dressing if properly applied. I do not consider that I gave it a fair trial, as I merely sowed it broadcast on a piece of wheat, and a continuance of dry weather followed directly after.

I consider it most likely to prove beneficial if drilled in with the seed, more particularly turnips, which plan I should be induced to adopt next season, if I can procure it good, and at a reasonable price.

I am, Sir, yours respectfully,

SAMUEL MOSSMAN.

During the last year many other gentlemen have tried it with good success, not only in Bedfordshire but in other counties. In Norfolk, some of my friends report favourably upon it. Mr. Francis Spalding, of Keswick, writes to me as follows:—

My dear Sir—I have been so unfortunate as to lose nearly my whole crop of corn, by the late hail storm which passed over my farm, only two days previous to the commencement of harvest.

I only tried the chemical manure for wheat at two cwt. per acre, sown broad-cast in the spring, upon good mixed soil land, against nine loads per acre of farm yard manure, set on in the usual way at the time of putting in the seed, and up to the time of the storm the appearance of the crop was most satisfactory. The ears were even and well filled, and I have every reason to think that the produce would have been found fully equal to that of the farm yard manure.

As a proof of the beneficial effects of this manure as a top dressing for wheat, I intend using it to a considerable extent another season, and shall also make trial of some drilled in with the wheat this year.

I am, dear Sir, yours truly,

F. SPALDING.

Keswick, October 9th, 1843.

Mr. Spalding has used the manure this season by drilling it in with seed wheat, and I look with confidence to a favourable result.

My friend, John Oddin Taylor, Esq. made trial of the manure last Spring as a top dressing for wheat, and reports very favourably of the result.

Mr. George Blake also tried the manure against guano and several other manures, and he, as well as some of his friends who are excellent judges of growing crops, preferred the corn for which the chemical

manure was used to any of the others; but unfortunately the crops were not kept separate before they were threshed, and consequently the product of each could not be ascertained.

I lament to observe (with some few exceptions) the laxity and carelessness with which agriculturists conduct such important experiments. They ought to cultivate the inclination to observe the growth and produce of their crops in every stage of their experiments with manures, or they will never arrive at any satisfactory results.

One such experiment accurately made—noting the cost of manures—the quantity applied—the cost in labour of application—the produce in straw and in grain, both by weight and measure—the weight per bushel of the grain, compared with the crop produced by ordinary manuring, with its expences and produce calculated, is worth a hundred *opinions* of even the most experienced farmers, for the result must be TRUTH.

I may venture to say, my Lord, that the "Chemical Manure Company" prepares its manures in as great perfection as a knowledge of the present state of chemical science can direct. They are composed solely of ingredients which are known to be essential to the nourishment of plants, and they supply to the soil that which has been partially abstracted by a preceding crop. They contain the phosphates, and the alkaline and ammoniacal salts, as well as substances furnishing, by slow and gradual decomposition, a con-

stant supply of their saline and azotized matters to the growing crop.

To presume that a manure could be formed that would do equally well for *all* kinds of soil would be absurd, as scarcely any two fields are alike in *natural* composition. Still as certain substances are known to be absorbed by all plants, and unless these are present in the soil, plants cannot thrive; *that manure* which conveys to the soil those essential substances in the best form, and in the most proper proportions must, I conceive, be the best for general application.

Liebig says "That no seed suitable to become food for man can be formed in any plant without the presence and co-operation of the phosphates. A field in which phosphate of lime or the alkaline phosphates form no part of the soil, is totally incapable of producing grain, or peas, or beans."

It would be madness to say that the manures of "The Chemical Manure Company" may not be improved, for chemical discoveries are proceeding with such rapidity, that what may be considered as perfect in one year, in the next may be found susceptible of still further improvement. All that I can say is, that they are compatible with, and prepared in exact accordance to, our present knowledge of the subject; and I think, as far as they have been tried, the experiments have proved them efficacious. The Company, as well as others who may pursue a similar course, must have extensive and accurate trials made of their manures, and the agriculturists must do their part before the

results of extended trials can be arrived at; and your Lordship is solicited, as President of the Norfolk Agricultural Association, to use your influence in prosecuting such experiments.

"The discovery that a theory is erroneous brings us nearer to that which is right, and by successive exclusions we advance gradually to the truth. Science affords but few instances where opinion has settled on what is right, before it had wandered through all the suppositions that are wrong."

Liebig says, "To THE UNITED EFFORTS OF THE CHEMISTS OF ALL COUNTRIES WE MAY CONFIDENTLY LOOK FOR A SOLUTION OF THESE GREAT QUESTIONS, and by the aid of ENLIGHTENED AGRICULTURISTS we shall arrive at a RATIONAL SYSTEM OF GARDENING, HORTICULTURE, AND AGRICULTURE applicable to every country and all kinds of soil, and which will be based upon the immutable foundation of OBSERVED FACTS AND PHILOSOPHICAL INDUCTION."

Begging your excuse for troubling you upon this subject,

I remain, my Lord,

Your Lordship's obedient servant,

WM. STARK.

Norwich, January 30th, 1844.

BACON AND CO. MERCURY OFFICE, NORWICH.